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EXAMINER	
WOODS, ERIC V	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/644,829	Applicant(s) SATOH, KIYOHIDE	
	Examiner Eric Woods	Art Unit 2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 January 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,5,7-12,17,19,20,24 and 26-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,5,7-12,17,19,20,24 and 26-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 20 January 2006 has been entered.

Response to Arguments

Applicant's arguments, see Remarks and amendments to the claims, filed 20 January 2006, with respect to the rejection(s) of claim(s) 1-28 under 35 USC 103(a) have been fully considered and are persuasive.

Therefore, the rejection of claims 1-28 has been withdrawn in view of applicant's amendments to the claims.

Claims 2, 4, 6, 13-16, 18, 21-23, and 25 have been canceled.

However, upon further consideration, a new ground(s) of rejection is made in view of various references as below.

Examiner takes issue with applicant's blanket assertion that support for all elements within the amended claims find their support in the specification. A bit more information is required to make that assertion. Applicant should at least provide the approximate location in the originally filed specification where the amended elements have support. A blanket statement such as the above is only a broad, conclusory

statement and cannot be regarded as having either factual or probative value (see *In re Geisler*) since arguments and statements of counsel are not given the above weight.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> **Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.**

Claim 26 stands rejected under 35 U.S.C. 101 because it is directed to a computer program per se, which is the quintessential abstract idea. See the Interim Guidelines for Patent Subject Matter Eligibility. It further does not meet the standards set forth by *In re Lowry* or *In re Beauregard* for properly claiming a computer program product.

Claim 27 is rejected under 35 USC 101 as unpatentable because it is directed to a computer program per se. A computer program must be must both **functionally** and **structurally** interrelated to the underlying medium upon which it is placed to be statutory (see *In re Warmerdam*). The claimed 'storage medium' is **not** functionally interrelated, since the computer does not execute the method of claim 21. The claim should be worded such that a computer is required to execute the method. Next, the storage medium **must** be computer-readable in order for it to be executed in the first place. Since the preamble of the method to claim 21 does not specify that the method is **computer-implemented** the claim can also be regarded as **inoperable** because there is no mechanism by which mechanism exists to read the computer and then execute it.

In order for the above claim to be statutory, it needs to recite that the "storage medium" is computer-readable and that the program stored thereon is for making a computer execute the program. Otherwise, such an embodiment would amount to functional descriptive material on a non-functional medium (e.g. computer code written on a piece of paper) that could not be transferred to a machine to cause it operate in some desired manner (see *In re Alappat* and *In re Warmerdam*). They further fail to generate concrete, tangible, and practical applications, since a computer program per se is certainly not tangible and concrete, and a 'storage medium' that cannot be used by a computer to execute the method (or that merely contains data of an any sort) lacks both a 'specific, substantial, and credible' utility, and certainly does not provide any practical benefit, and furthermore would not be concrete in the sense that the CAFC determined the term in *State St.*)

Therefore, both of the above claims are prima facie nonstatutory.

The claims rejected above under 35 USC 101 as nonstatutory are further rejected as set forth below in order to expedite prosecution in the expectation that applicant will amend the claims to place them within one of the four statutory categories of invention.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> **The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.**

Claims 24 and 26-28 are rejected under 35 U.S.C. 112, first paragraph, as based on a disclosure that is not enabling. A computer, which is critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). That is, the method requires a computer in order to practice it (see for example element 210 in Figure 2, element 310 in Figure 3, and the like, within the instant specification, which clearly illustrate that the image pickup device (camera) is clearly connected to a computer or computer-based unit, which therefore clearly requires such for the method as well. The preamble of these claims (independent) **must** be amended to read 'A computer-implemented method for ...'

Claims 1-28 are rejected under 35 USC 112, first paragraph, as based on a disclosure that is not enabling. Simply put, the claims require 'an image pick-up device having a fixed positional relationship with respect to a measurement object'. This recitation has no support in the specification –see for example claims Figures 2 and 3, where the invention is embodied in a system with a HMD (head-mounted display) on a user who is moving around. The display would contain both an attitude sensor and a camera. This camera would in fact **inherently** not have a 'fixed positional relationship' with respect to a measurement object. A moving user simply does not remain in a fixed position. The recitation only has meaning in an instantaneous context, that is, when the attitude and position sensors take a snapshot at a particular instant in time, the camera will have a fixed relationship to the object it is viewing only for that instant of sampled,

discrete time. However, the recitation in the claim does not recite that. It only states that the fixed positional relationship exists. Dictionary.com defines 'fixed' as:

1(a) To place securely; make stable of firm: *fixed the tent poles in the ground*

2(a) To put into a stable or unalterable form: *tried to fix the conversation in her memory*

3 To direct steadily: *fixed her eyes on the road ahead*

5(a) To set or place definitely; establish: *fixed her residence*

5(b) To determine with accuracy; ascertain: *fixed the date of the ancient artifacts*

As noted above, definition 5(b) appears to be the closed to the intended meaning. The instant specification and/or intrinsic record does not support the meaning of the term 'fixed' in this context, thusly examiner turns to a dictionary to determine a proper meaning. This meaning is **not** inconsistent with the disclosure of the instant specification, because the invention is enabled for a system with a moving user as discussed above. Therefore, the above rejection is entirely consistent with the multi-part analysis and reliance on both intrinsic and external records as per *AWH v. Phillips* (CAFC 2005).

However, examiner does note that the instant specification does set forth that for certain situations, particularly outdoors, the distance from the observer to the target object is sufficiently large that a certain distance is chosen as the 'fixed distance' and that number is used, since the calculations can tolerate a certain amount of error. Therefore, in order to correct the above problem, applicant needs to amend the first

clause of the independent claims to add **'with limited precision'** to make clear that the fixed position relationship is in fact being approximated based on less than the best available information to simplify computation and the like. As originally written, the first clause of claim 1 is not clear on this point.

As currently written, the independent claims recite generic limitations ('fixed positional relationship') that is only enabled for one particular embodiment, that of the approximated position with a certain amount of error, as described in the instant specification. The CAFC decided *LizardTech* in 2005, which held that a claim reciting a method that had scope over and covered all method of generating seamless DWT images was not enabling and was indefinite because the specification only described one embodiment that did not enable the generic claim for generating **all** seamless DWT images. Therefore, applicant **must** amend the claims in order for them not to be struck down by the Board or the CAFC.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1 and 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Specifically, applicant uses the terminology 'adapted to' in the independent claims, which has been held by the CAFC to be both vague and indefinite. This terminology means that the system is not **required** to perform that functionality, but

rather that it only **may** have that form, function, or required functionality. As such, any limitations that use the "adapted to" language are prima facie indefinite and therefore can be ignored in construing the claims.

The terms 'adapted to' are exemplary language that requires three things: 1) that there be sufficient structure to provide for the language [in this case, the instant claims fail because they do not provide sufficient structure to provide for the language's presence], 2) that the scope of the invention be clear [in this case, it is not, because it is unclear whether or the claimed feature is critical; thusly, any element without criticality is optional under that above language; the specification is not enabling for those elements as optional], and 3) that the functional language is supported by the specification [in the instant case, it is not; the specification clearly requires that the system have all of the above components as units or steps; their omission would **NOT** necessarily perform the same function as before].

Claims 3, 5, 7-12, 17, and 19 are rejected as not correcting the deficiencies of their parent claim(s).

Additionally, claims 24 and 28 are illustrative of the fact that the elements are **not** optional but are required, since there is a one-to-one mapping of elements from the system to the method in the instant claims.

Claims 1 and 24 are further rejected under 35 USC 112, second paragraph, because the words 'fixed positional relationship' are found to be indefinite. The specification does not provide a clear standard for the meaning of this terminology, and it is therefore indefinite because the 'fixed positional relationship' could be between the

camera and the object only during one phase of measurement, and such a relationship must always have a frame of reference (e.g. specific location of both object and camera, specific distance between two points, or the like), where this is not provided by the various elements in the claims.

Further, examiner submits that the recitation of the 'fixed positional relationship' renders the claim indefinite because it constitutes a mixing of a system claim and a method of using that system, thusly creating undue confusion as to what precisely the requirements for the system claim should be.

Definitions

Note that the term 'index' in the claims below was defined in the instant specification (and in the PGPub for the instant application, US 2004/0090444) in the following statement:

[0051] The corrected value operation process is basically performed on the basis of the observation prediction position of the landmark on the image predicted from the sensor output and the observation position on the image of the landmark actually detected by the image processing, employing a landmark (e.g., a real object (or a part) that can use the features of an image for its projected image as an **index** of alignment such as the corner of the building or the roof of the house). Accordingly, it is the maximal point of the corrected value operation process how to detect the observation position of landmark from the image correctly and stably.

Thusly, the term 'index' in reality means 'index of alignment' which further means a portion or segment of the base image that is to be used for template matching (e.g. the corner of a house).

The term 'roll angle' is never used in the specification. However, the 'roll direction' is referred to in the specification, where the image is rotated through a rotational angle to correct it. It is assumed that the discussion in 4:20-5:2 of the instant specification is the controlling definition.

It is requested that applicant clarify the support in the instant specification for the term 'roll angle' so that examiner can determine whether or not the amendment in fact complies with 35 USC 112, first paragraph, with respect to the written description requirement. A lack of complete response will result in all claims being rejected under 35 USC 112, first paragraph for new matter.

Interpretations

The independent claims are not enabled and/or suffer scope of enablement issues. As such, the phrase 'fixed positional relationship' is being interpreted as set forth in the specification (see PGPub [0046]). That is, the position of the other object can be assumed to be fixed when the distance is great enough and otherwise the determination of position for the measurement object can be ignored if the position of the measurement object is known, etc.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Already in the action see pg 3.

Claim 26 is rejected under 35 U.S.C. 101 because it is directed to non-statutory subject matter. Claim 26 is directed to a computer program per se. It needs to be combined with claim 27 in order to be statutory. The claims rejected above under 35

USC 101 as nonstatutory are further rejected as set forth below in anticipation of applicant amending the claim to place it within one of the four statutory categories of subject matter.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1, 9, 17, 19-20, 24, and 26-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundareswaran et al (US 6,330,356) in view of Kim et al (5,933,530) and Chen (5,765,561).

[Method (claim 24) and system (claim 1) are properly subject to the same rejection when identical, and the computer program product claims are identical to the method claim (claim 24) and are executed by a computer, which therefore means that they are same (claims 26-27)]

As to claims 1, 24, and 26-27,

An image processing device comprising: (Preamble is not given patentable weight, since it only recites a summary of the claim and/or an intended use, and the process steps and/or apparatus components are capable of standing on their own; see Rowe v. Dror, 112 F.3d 473, 42 USPQ2d 1550 (Fed. Cir. 1997), Pitney Bowes, Inc. v. Hewlett-Packard Co., 182 F.3d 1298, 1305, 51 USPQ2d 1161, 1165 (Fed. Cir. 1999), and the like.)

-An image pick-up device having a fixed positional relationship with respect to a measurement object; (Sundareswaran Figures 1 and 10, object 24 has a fixed position with respect to camera 20, at least in the context of the instant specification and its meaning – see 5:5-35 for head-mounted camera on user, where the display is head-mounted as well (5:49-54). Note next 8:55-65, which clearly states: "The actual camera position and orientation is not directly 'known' by (accessible to) the module, except as a current best estimate..." This is clearly comparable to the technique used in the instant specification, as described and discussed in the above rejection of claim 1 under 35 USC 112, first paragraph, as lacking enablement.)

-An orientation sensor adapted to measure the orientation at an image pick-up visual point of said image pick-up device; (Sundareswaran Figure 1, 5:20-30, the system uses the camera to track positions of various portions of the object (e.g. natural features of the object - 5:10-12). These are used to measure the orientation of the device, specifically (abstract, 4:5-35))(~~Chen 10:30-11:6 Column 11, lines 7 – 11, states, "More particularly, and looking now at FIG. 8, there is shown a video camera 45, an anatomical structure 60, and a tracker system 65. Tracker system 65 comprises a~~

tracker 70 which is attached to video camera 45, and a tracker base 75 which defines the coordinate system of the tracker system." Thus, Chen et al. teaches of an orientation sensor for measuring the orientation of the video camera (see 3:65-4:10).)

-A storage unit adapted to store calculation information to calculate the orientation of said measurement object or the position of said measurement object on the basis of an output from said orientation sensor; (Sundareswaran inherently requires this, since the system maintains registration between a virtual model and the actual position of the camera on the user with respect to the object – see for example 4:10-21, where such a storage device is part of the image processing host 30 as shown in Figures 1 and 10. Next, note 6:35-65, where a potential application is described in detail, particularly illustrating that once the position is known, it is continually tracked to maintain registration, which therefore *a priori* requires the storage of the previous position and orientation (Abstract, 4:10-21, 8:55-65, etc). The output from the orientation sensor is used to establish the position, as it tracks the position of landmarks or fiducial marks (which as noted above can be natural and inherently part of the object))

-A prediction position calculation unit adapted to calculate a prediction position of an index in an image picked-up by said image pick-up device on the basis of the measured orientation; (Sundareswaran clearly teaches in Figure 9, 6:35-60, 8:57-65, 10:57-65, that the coordinate values of the **predicted** feature positions are used. Note step 250 in Figure 9, where the position is predicted 'Compute Difference Vector between Predicted and Measured Marker Positions'. This therefore requires that the position be predicted based on the measured position. Note 8:57-65, where only the current best estimate of

camera position is provided to the module to perform registration and generation of the 3D module from the virtual camera, thusly the predicted position of the virtual camera is based on the basis of the previously measured orientation as above)~~(Chen (3:65-4:10) lines 12 – 17 disclose matrix transformations from the patient to the camera, the camera to the tracker base, and the patient to the tracker base. Thus, calculation information is stored in the matrix transformations to calculate the orientation of the patient on the basis of an output from the tracker system.)~~

-A target image-setting unit adapted to extract an image area of the index from the picked-up image on the basis of the prediction position of the index, rotate the extracted image area using a roll angle, according to the measured orientation, of said image pick-up device, and output the rotated image area as a target image; (Sundareswaran 5:20-23, 8:57-67, etc – the marker or feature locations are extracted and their positions are used to determine the orientation of the object – where these extracted markers are clearly the 'index' referred to as in the 'definitions' section, and this reference is specifically enabled for using natural features of an object. Clearly the positions of such features are determined, the system would output the overall location of that marker image ... see for example 10:57-67, where the feature positions are the marker locations suitably extracted by the algorithm. Several things are calculated based on this – both T and Ω (rotation matrix) – 10:35-40, which clearly shows that the marker positions are extracted and rotated by Ω, and then output to determine T, the position matrix)

-A detecting unit adapted to detect the position of said index in said target image by performing a template matching process between a template image of said index and said target image; (Sundareswaran clearly teaches that pattern matching can be used for this kind of applications, such as in 2:39-55, and in Figure 4 provides an example of a template for a marker. In 8:25-30, Sundareswaran mentions that template matching is an option but is currently not used because of computational cost.)

-An updating unit adapted to update said calculation information stored in said storage unit on the basis of a detected position of said index detected by said detecting unit; (Sundareswaran clearly teaches in 10:55-67 that the position and orientation information are updated – 6:65-7:5, where the storage unit is inherent as described above)~~(Chen Column 11, lines 18 – 29, describe an updating of the calculation information on the basis of a detected position of a marker in the patient image then calculating the orientation of the patient in relation to the tracker system on the basis of known values and the updated calculation information from the matrix transformations)~~

-A calculation unit adapted to calculate the orientation and/or position of said measurement object on the basis of a measured value from said orientation sensor and said calculation information updated by said updating unit. (Sundareswaran clearly calculates the changed position, see Figure 7, where the position is calculated based on the updated information, where the process loops endlessly to update the tracking position and create the new best estimate as discussed above, where Figure 9 also shows this in step 256 ('Update 3D camera parameters (position, orientation)))~~(Chen teaches that once the virtual image generated by image generator 30 has been placed~~

in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system.")

Sundareswaran teaches all the limitations of the instant claim except actually using template matching to perform the pattern matching, but rather uses an edge detection system that approximates template matching at a lower computational cost. The background of Sundareswaran implicitly teaches that template matching is the preferable method but for the increased computation cost involved. The system of Kim et al provides a more efficient method of template matching that only extracts a small area and performs the regional comparison in real time so that the cost overhead present in the use of a template matching technique (the computational cost as above) is therefore not an issue (9:1-40), which is an improvement over previously used template matching region (Abstract). Therefore, since this provides a simplified template matching algorithm which can operate in real time, which algorithms are known to be more efficient (see the Background of Sundareswaran), it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Sundareswaran to utilize template matching instead of edge detection, particularly when

using natural features of a recognition object instead of the circular fiducial marks of the preferred embodiment, since an arbitrarily-shaped mark would need template matching in order to be located. The system of Kim operates in a real-time manner, which therefore does change the principle of operation of the system of Sundareswaran.

Sundareswaran does not expressly teach having an orientation sensor per se on the image pick-up device. The system of Chen provides that having such a sensor is very important (10:30-11:5) for maintaining registration accuracy during a surgical procedure (which would also be critical during repairs on complex machinery and the like, as discussed in Sundareswaran). As such, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Sundareswaran to have such an orientation sensor, if only as a back up to provide additional information under certain circumstances, since it is critical to always have such information as per Chen. Chen also utilizes fiducial markers to maintain orientation and registration, and as such is analogous art with and to Sundareswaran. Finally, Sundareswaran is being combined with some of the teachings of Chen (the orientation sensor and certain details of calculating) to hold registration accuracy and reduce registration error. It should be noted that the system of Sundareswaran recalculates position after updating it, which therefore takes care of the last clause of the claim.

As to claim 9,

Chen et al. discloses the device of claim 9. Column 11, lines 12 – 29, discloses calculation information in the form of matrix transformations for calculating the position and attitude of the patient on the basis of the measured value and position information

of the pick-up visual point of the camera in regard to the tracker system. "In this setting, M.sub.PC can be considered to represent the matrix transformation from the patient's anatomical structure 60 to camera 45; M.sub.CT can be considered to represent the matrix transformation from camera 45 to tracker base 75; and M.sub.PT can be considered to represent the matrix transformation from anatomical structure 60 to tracker base 75.

M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system." Therefore, the calculation information is updated once the virtual image is placed in registration with the real image generated by the camera and the matrix transformations are formed.

As to claim 17, Sundareswaran teaches that the measurement object is an image pickup visual point (see rejection to claim 19 below and 5:5-55), where the display unit is a HUD and overlays the virtual image on the real world in accordance with the determined position and orientation so as to maintain registration between the real world and the superimposed images in the virtual space using the calculation unit as described in the rejection to claim 1 above.

As to claim 19, Sundareswaran clearly teaches a HUD (heads-up display) that a user can wear with the camera being placed on the user's head (5:5-55). This therefore provides that the measurement object is visual point of the observer, and the virtual image is always overlaid with the real world image as required by the calculation image, since registration is maintained between them, and the image is clearly optically transmitted in the real space through the display screen as described above.

As to claims 20 and 28, these are duplicates of claims 1 and 24 in some ways. It omits various elements of claims 1 and 24. The CCPA ruled *In re Karlson* that the omission of an element and its function in combination is an obvious expedient if the remaining elements perform the same functions as before. *In re Karlson* (CCPA) 136 USPQ 184 (1963). The omitted elements are: a storage unit, an updating unit, and a calculation unit. Method and system and subject to the same rejection as explained above.

Claims 3, 5, 7-8, and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sundareswaran, Kim, and Chen as applied to claim 1 and further in view of Rallison et al.

As to claim 3,

Sundareswaran, Kim, and Chen disclose the device of claim 3 except wherein said calculation information is the correction information to correct for an error in the measured value of attitude measured by said attitude sensor of the image pick-up visual

point of said image pick-up device, and said calculation unit calculates attitude of said measurement object on the basis of the measured value and correction information. The invention of Rallison et al. teaches of tracking the position and attitude of an image generator mounted on the head of a person. Column 19, lines 11 – 26, teaches of the various types of tracker systems including magnetic and inertial sensor systems. Columns 21, 22, and 23 explain obtaining position and attitude orientation with the two systems. Column 24, lines 37 – 67, and column 25, lines 23 – 62, describe correcting for an error in the measured values of attitude and position taken from the sensor systems. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Sundareswaran and Chen to include using an inertial sensor system as the tracker system for the video camera. One would have been motivated to make such a modification to Sundareswaran since inertial sensors such as rate gyros will have the advantage of being substantially immune to magnetic perturbations that may be present in the area around machinery. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to correct for an error in the measured value of attitude information of the inertial sensors for use in the matrix transformation calculations of Sundareswaran. One would have been motivated to make such a modification to the invention of Sundareswaran so that the calculated position and attitude information of the camera and patient remain accurate while performing a repair on complex machinery.

As to claims 10, 11, and 12,

Chen et al. discloses the device of claims 10, 11, and 12. Column 11, lines 12 – 29, discloses calculation information in the form of matrix transformations for calculating the position and attitude of the patient on the basis of the measured value and position information of the pick-up visual point of the camera in regard to the tracker system. "In this setting, M.sub.PC can be considered to represent the matrix transformation from the patient's anatomical structure 60 to camera 45; M.sub.CT can be considered to represent the matrix transformation from camera 45 to tracker base 75; and M.sub.PT can be considered to represent the matrix transformation from anatomical structure 60 to tracker base 75. ....

M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system." Therefore, the calculation information is updated once the virtual image is placed in registration with the real image generated by the camera and the matrix transformations are formed. Additionally, column 12, lines 35 – 37, describes using a least squares fit to correlate the sampled points with the patient-specific images. Thus, a typical value is used that

incorporates a dislocation value between the predicted position and the detected position of a plurality of markers from a real and virtual image.

As to claim 5,

Sundareswaran, Kim, and Chen disclose the invention of claim 5 except wherein said calculation information is the correction information to correct for an error in the measured value of attitude measured by said attitude sensor and the position information of the image pick-up visual point of said image pick-up device, and said calculation unit calculates the position and attitude of said measurement object on the basis of the measured value, correction information, and the position information. The invention of Rallison et al. teaches of tracking the position and attitude of an image generator mounted on the head of a person. Column 19, lines 11 – 26, teaches of the various types of tracker systems including magnetic and inertial sensor systems. Columns 21, 22, and 23 explain obtaining position orientation with the two systems. Column 24, lines 37 – 67, and column 25, lines 23 – 62, describe correcting for an error in the measured values of attitude and position taken from the sensor systems. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include using an inertial sensor system as the tracker system for the video camera. One would have been motivated to make such a modification to Chen since inertial sensors such as rate gyros will have the advantage of being substantially immune to magnetic perturbations that may be present in a medical operating atmosphere. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to correct for an error in the

measured value of attitude and position information of the inertial sensors for use in the matrix transformation calculations of Chen. One would have been motivated to make such a modification to the invention of Chen so that the calculated position and attitude information of the camera and patient remain accurate while performing a medical procedure.

As to claim 7,

Sundareswaran, Kim, Chen, and Rallison teach of the device of claim 7. Sundareswaran, Kim, Chen in view of Rallison teach of updating the position information with regard to a series of matrix transformations in column 11, lines 7 – 30. Additionally, column 9, lines 38 – 49, describe a search algorithm for automatically bringing a virtual image into registration with a real image. Column 10, lines 38 – 52, describes reestablishing the registration between a real image and a virtual image if the video camera position is moved. Thus, Sundareswaran, Kim, Chen, and Rallison teach of updating position information. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Sundareswaran, Kim, Chen, and Rallison so that the position information is only updated in two directions and not in a depth direction if the action is so desired by a user while reestablishing a registration between a real image and a virtual image. One would have been motivated to make such a modification to the invention of Sundareswaran, Kim, Chen, and Rallison so that if a user does not require an updated value in a depth direction, the computing system does not waste utilization time and resources calculating an unnecessary value.

As to claim 8,

Sundareswaran, Kim, Chen, and Rallison explicitly disclose the device of claim 8 except wherein the correction information is the information to correct for an error in the azimuth direction among the measured values of the attitude measured by the attitude sensor. In column 23, lines 60 – 67, and column 24, lines 1 – 23, Rallison additionally teaches of sensor drift, thus causing an error in the measured values of roll, pitch, and yaw.

The definition of the term 'yaw' is "to turn about the vertical axis. Used of an aircraft, spacecraft, projectile, etc." The definition of the term "azimuth" is "the horizontal angular distance from a reference direction, to the point where a vertical circle through a celestial body intersects the horizon, usually measured clockwise. Sometimes the southern point is used as the reference direction, and the measurement is made clockwise through 360 degrees."

Therefore, the amount of yaw is the amount of turn around a vertical axis, while the azimuth is the amount of turn around a reference direction. The two terms are synonymous in this context, e.g. the amount of yaw deviation, drift, or error, is equivalent to amount of azimuth deviation, drift, or error.

Thus, it is inherent that the use of a gyroscopic tracking system in the invention of Sundareswaran, Kim, and Chen in view of Rallison will accumulate an error in the measured directions, including the azimuth measurements. Therefore, the use of the yaw correction information in the matrix transformations in the invention of

Sundareswaran, Kim, and Chen in view of Rallison is equivalent to the use of the azimuth correction information.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Note US 5,878,156 to Okumura, which generates template images in real time so that the computational issues involved in normal template matching do not occur and that it makes template matching faster than the edge detection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric Woods whose telephone number is 571-272-7775. The examiner can normally be reached on M-F 7:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on 571-272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Eric Woods

May 23, 2006

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